

SUPPLY CONTROL ANALYSIS OF BADMINTON RACKET MATERIALS AT SENTRAL SPORT STORE USING EOQ METHOD

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ABSTRACT

Sentral Sport Store is a shop engaged in the field of sports equipment, one of the goods that is produced is a badminton racket. This store has difficulties in managing the supply of basic materials for its production racket. With these difficulties, there is excess storage of basic materials in warehouses, which require substantial costs. This problem occurs due to a lack of knowledge in analyzing basic material inventory as properly. Therefore, for business continuity, it is necessary to control the supply of basic materials. The purpose of controlling the supply of basic materials in this study is to help the store in carrying out the process of inventory of basic materials running optimally and can save the store's expenses.. In order for this goal to be achieved, the research uses a calculation process on the basis of the Economic Order Quantity. As a result of research with calculations based on the Economic Order Quantity, the total cost of inventory issued based on shop policy is IDR 1,229,166.653 with a purchase frequency of 89 sets of basic materials per order, while the total inventory cost on the basis of using EOQ is IDR . Rp. 625,704.458, - with the purchase of 339 sets of basic materials per order. Thus, the cost that can be saved and considered as a shop profit is Rp. 625,704,458, -. in one year.

Keywords: *Economic Order Quantity, basic materials, supplies*

INTRODUCTION

In running a business, there must be something called purchasing raw materials/products so that they can be produced and sold at the place where the business is run (Yuliana, Topowijono, & Sudjana, 2016). However, businesses that have a large or small scale in carrying out their activity processes can have quality standards that are on target and many demand by consumers. Thus, business owners in purchasing basic materials must find for good quality in order to get good production results as well (Amrillah, 2016). Based on the experience that occurred when purchasing raw materials to be produced carelessly, problems arose due to the lack of prior consideration. Likewise in managing inventory, if it is done without careful calculations, in purchasing these basic materials, excessive stockpiling of goods will occur.(Utama & Siswanto, 2017). Even though buying basic materials in large quantities will get cheaper prices, other problems will occur. With the hoarding of goods in the warehouse will incur even higher storage costs(Indrajaya, 2018). With the hoarding of these items can make the store run ineffectively. And in carrying out the production process of goods to be traded, it requires basic materials and complementary materials to produce a perfect production item. With this, business owners need to pay attention to the basic ingredients in the production sector.

In the changing times, enthusiasts of sports goods in Indonesia, one of which is the badminton racket, is developing not too fast and not too low either. Because most Indonesian people lack interest in sports, but try to have better potential and continue to develop. There are many sporting goods stores in Indonesia, one of which is Sentral Sport Store. Sentral Sport Store is one of the store that sells badminton rackets which are manufactured in such a way to get

perfect production results. One of the targets of this store is how consumers to know quality badminton rackets and easy to reach according to their individual needs. Therefore the store must support as well by other goods distribution parties and carry out a good marketing system so that the target is easy to achieve. With good support from several parties, the store can compete healthily with other stores that sell similar goods, in the process of gathering new consumers who have high interest in sports.

Sentral Sport Store is a store whose business started in 1992. Until now, it has been running about 30 years and still going strong today. In 1992, Sentral Sport Store started to establish, it only sold badminton rackets which produced by themselves by supported of basic materials and complementary materials from distributors. Over the time, Sentral Sport Store began to grow and began to add other sporting goods, however, other goods were not produced by themselves but purchased finished goods from other distributors. So this research is only focused on badminton rackets because they are produced by themself. The Sentral Sport store is located in Bekasi City, the sales system is carried out using an offline store and online store system through e-commerce and social media. With the existence of an online store sales system, it can provide opportunities for customers who want to become sellers of that part of the store. Ordering products online can usually be ordered 5 days before the product is sent to consumers.

Because there are so many enthusiasts of the badminton racket, the store always stocks basic materials and complementary materials to produce these badminton rackets, which are in great demand by consumers. So from these orders, there is excess stock of products, so there is hoarding of goods in the warehouse. This is due to the pandemic and difficulties in finding consumers who need these products. As for other impacts, such as the relatively take time to find consumers. With this impact, it can damage the products piled up in the warehouse, because too many products are stored in the warehouse. If left alone, the store will suffer huge losses and even threaten left of business.

Based on the stockpiling of goods in Sentral Sport's warehouse store, they feel that they have not been optimal in controlling the supply of basic materials. So they need an EOQ calculation method in order to control well ordering of goods by reducing inventory costs. Therefore researcher conducted research on the analysis of the EOQ method to control the inventory of basic materials at the Sentral Sport Store.

LITERATURE REVIEW

Economic Order Quantity

EOQ is a method of purchasing a number of inventory items that can be carried out as little as possible so that the total cost of all inventory items is low (Ayu A, Komariah, & Mulia Z, 2022) (Yuliana et al., 2016) (Yopan Maulana, 2018) (Saragi & Setyorini, 2014) (Fahmi Sulaiman, 2015). And EOQ is a way of managing inventory that was early and widespread, with an inventory management method so that it can solve problems, namely when to buy and how many items to buy (Suryani et al., 2022).

The EOQ technique is a technique used in the process of calculating the minimum amount and price of stock to increase the diagram of holding costs and ordering costs (Rully Mujiastuti, 2020) (Rorim Panday; Novita Wahyu; Dewi Sri; Cahyadi Husadha, 2020). (Hudzaifah Dohar Pardomuan Marbun, 2015), said that basically the Economy Order Quantity technique is a technique in the process of determining the lowest number of orders for goods in one order process (Septiawan & Panday, 2021). The Economy Order Quantity technique can be used as a technique that can align problems with managing raw material inventory and can be said to be

the oldest control technique, thus obtaining a low total cost of supplying raw goods. The EOQ technique is needed in the process of purchasing several kinds of basic materials maximally and can cut the cost of stocks that need to be issued by the company or shop (Rorim Panday, 2021). In calculating the Economic Order Quantity, there are 2 costs that must be considered, namely ordering costs and storage costs (R. Panday, Rachmat, & Navanti, 2020) (Pradana & Jakaria, 2020).

The calculation techniques used are: EOQ calculation, total inventory cost, safety stock, and reorder point. The following is a systematic equation of each calculation using EOQ (Heizer, J., & Render, 2014) (Hillier & Lieberman, 2010) (Blumenfeld, 2009) (Onawumi, Oluleye, 2011) (Birbil, Bulbnul, J.B.G.Frenk, n.d.) (Tibrewala & Kleinstein, 2000):

1. The EOQ calculation is carried out in order to calculate the amount of materials needed in every purchase of goods at a low cost. The formula that can be used is:

$$EOQ = \frac{\sqrt{2SD}}{H}$$

annotation :

EOQ : The optimal amount of orders

D : Total demand for basic materials/year

S : Order cost in one order

- 3 H : Cost of holding one product per year

2. Calculation of the total cost of inventory is carried out for inventory of basic materials that can be used in checking an inventory purchasing process with the EOQ system whether it is getting better or not. The formula that can be used is: $\left(\frac{D}{Q}S\right) + \left(\frac{Q}{2}H\right)$

Annotation :

EOQ : The optimal amount of orders

D : Total demand for basic materials/year

S : Order cost in one order

H : Cost of holding one product per year

3. Calculation of safety stock is carried out in order to strengthen the company from various problems that arise due to inventory. Before calculating the previous safety stock, you can calculate the deviation value or standard deviation first. The formula that can be used is

$$\text{Standar deviasi (Sd)} = \frac{\sqrt{\sum(x-\bar{x})^2}}{n-1} \text{ dan Safety stok} = Sd \times Z$$

Annotation :

Sd : Standard deviation

x : Total demand basic materials

\bar{x} : Average demand of basic materials

Z : normal Value

4. Reorder point calculations are carried out in order to monitor available goods, so that goods can be ordered with the appropriate waiting time. But you can look for the use of basic ingredients in time per day. The formula that can be used is:

$$d = \left(\frac{D}{t}\right) \text{ dan } ROP = d \times L$$

Annotation :

d : Total demand basic materials/month/ day

D : Total demand basic materials /year

t : Total work-time/year

L : Lead time

The purpose of the Economy Order Quantity is the process of reducing all costs that increase little by little on a regular basis according to the cost of purchasing goods issued and profits as desired (Pujiastuti & Ariyani, 2021). The other purpose of the EOQ is the activities carried out in ensuring the supply of basic materials at a company or store (Senthilnathan, n.d.). And in business activities it is obligatory to carry out a good planning process in order to expedite production activities (Simbolon, Sunarsih, & Kartono, 2021).

The form of the Economy Order Quantity is objective recording in support of efforts to increase the supply of goods that should be provided at a cost that is in accordance with the maintenance process and consumer expectations. The form of the Economy Order Quantity value can be based on implied assumptions, with the advantages of special goods and technical deficiencies in conducting goods investigations. And the Economy Order Quantity form is used as a product payment process after receiving goods from distributors. As a result of product damage and reverse inventory techniques in determining decisions. By maximizing the reverse inventory technique, the business can be useful for a long time.

Inventory

Large or small companies that carry out their business in the manufacturing sector in their business activities obtain goods that have good advantages so that they can meet the expectations of consumers. So that these consumers can feel satisfied in using the goods from the results of operations and if the inventory has a large volume it can result in the company not running smoothly.

The meaning of Inventory is goods for manufacture in the next stage. Inventories are products that are stockpiled to be transferred in the future (Ratningsih, 2021). The ideal stock of basic materials is a way to revive the business of producing goods. And it can be explained that stock is a company asset in the form of basic materials. In general, there are three types of inventory, namely raw material inventory, process form inventory, and finished goods inventory (Fahmi Sulaiman, 2015) (Mukesh Bhagoria, 2010)(Yusuf, 2003)(Juwari, Kusri, & Pramono, 2018). Inventory preparation technique is a set of rules in planning inventory stages that must be protected. So, the main meaning of inventory is the arrangement of determining, maneuvering, and directing the purpose of which is for the company to be able to properly check the total inventory in the filing process and to be able to promote the maximum use value of the published filing costs..

Previous Research

Research on EOQ has been carried out by (Mathew, 2013) (Rorim Panday; Hernawati, 2015) (Emmanuel Adjin Okwabi, 2014) (Al-salamah, 2011) (Ameli, Mirzazadeh, & Shirazi, 2008) (Rezaei & Salimi, 2012), which in all research when used the EOQ method in inventory management on each research object, has been proven to reduce total inventory costs and minimize reordering and optimize ordering frequency.

RESEARCH METHOD

The data obtained from this study were obtained by conducting interviews with store owners who were entrusted with managing the running of the store. This research is directly carried out at the Sentral Sport Store location, Bekasi, from September 2022 to October 2022. The calculation method used the Economic Order Quantity and the required data such as: the

ordering cost, the holding cost, and some data ordering goods. After all the necessary data has been obtained, calculations are carried out using the EOQ formulas.

ANALYSIS AND DISCUSSION

In Sentral Sport Store, to produce badminton rackets that will be traded, the main basic material is wood which is made of carbon fiber. The wood is obtained from regular distributors located in Cirebon. Sentral Sport Store orders the wood once a month with a waiting time of approximately 10 days. The wood can be used by Sentral Sport Store, approximately 1,068 pieces are needed. Which is given a price by the distributor of Rp. 85,000 for a wooden rack in the shape of a racket. And of course the wood chosen for the rackets being sold uses fiber wood of good quality.

As for complementary basic materials for badminton rackets, Sentral Sport Store requires strings and rubber to protect the racket handles. These complementary materials are ordered by Sentral Sport Store at a regular store that sells strings and protective rubber for racket handles located in Tangerang. In a year, approximately 1,068 pcs of strings were purchased at the price given by the subscription store of Rp. 15,000/string. Whereas for the purchase of protective rubber for racket handles in a year, approximately 1,068 purchases are purchased at the price given by the subscription store of Rp. 10,000/rubber. For more details, we can see as follows:

Table 1. Basic Material Data of Sentral Sport Store

Badminton Racket Wood	1.068 pcs
Strings	1.068 pcs
rubber for racket handles	1.068 pcs

Source : Sentral Sport Store

So, the product produced by Sentral Sport Store is a badminton racket. In this case, accuracy is needed in controlling the supply of the main basic material, namely wood made of carbon fiber. Because these main raw materials have a big influence on the production of badminton rackets, with this there is often a problem that the Sentral Sport Store experiences quite a long waiting time as a result of delays in the delivery of these main basic materials. So that Sentral Sport Store must purchase optimal raw materials in order to minimize inventory costs and the production process runs well. The supply of basic materials in Sentral Sport Store's warehouse is still sufficient because they do not run out directly in the production process of the badminton racket. This is done so that the store has a reserve base material to anticipate sudden requests. The total number of Sentral Sport Store badminton rackets that are produced within a day to get the perfect badminton racket finished product is between 5 pcs, 4 pcs and 3 pcs. But if there is a decrease in the number of requests, the Central Sport Store reduces the total daily production to only 2 pcs.

Data on the need for basic materials for racket strings in 2021 can be presented

Table 2. Data of Basic Material Requirements for 2021

No	Month	Total wood (pcs)
1	January	53
2	February	57
3	March	67

4	April	68
5	May	106
6	June	132
7	July	150
8	August	124
9	September	97
10	October	42
11	November	93
12	December	79
Total requirement basic material/year (D)		1.068
Average requirement/month (\bar{x})		89

Source : Sentral Sport Store

From the data above, it can be seen that the number of purchases of the basic material for badminton rackets in 2021 is 1,068 sets. In a time frequency of ordering once every 1 month, so a year the basic materials are ordered to distributors 12 times. And we can conclude from the data table that purchases of basic materials each month increase and decrease depending on the level of consumer demand. The highest purchase of basic materials for stranded wood was in July as many as 150 sets of wood, due to the holiday season, many school children like to play sports together. And the purchase of the basic materials for wooden was at least 42 wooden frames in October, because the total demand decreased due to the holiday season being over and the community returning to their respective activities so that the racket production was reduced. The ordering costs arise due to the process of sending goods from distributors to deliver the ordered raw materials. Therefore, Sentral Sport Store presents a detailed table of ordering rates as follows:

Table 3. Ordering cost for Frame woods

No	Type of cost	Total. cost (IDR)
1	Communication cost	200.000
2	Shipping costs	600.000
3	Delivery administration cost	350.000
Total		1.150.000

Source : Data compiled

Total ordering cost wood frame by Sentral Sport Store in 2021 year as much as IDR 1.150.000.

Sentral Sport Store also takes into account storage costs that arise due to the storage of a unit. Therefore, Sentral Sport Store presents a detailed table of storage costs as follows:

Table 4. Data on the holding cost of framed timber

No	Type of cost	Total Cost (IDR)
1.	Cost of electricity for storage in the warehouse	400.000
2.	The cost of storing reserves for defective goods in the warehouse	1.500.000
Total		1.900.000

The total cost of storing the lumber by Sentral Sport Store in 2021 is IDR 1,900,000. Then the calculation process can be carried out for ordering costs and storage costs for these goods, namely:

For the calculation of the cost of ordering each message is

$$S = \frac{\text{Total Ordering cost}}{\text{Ordering Frequency}}$$

$$S = \frac{\text{IDR. 1.150.000}}{12}$$

$$S = \text{IDR. 95.833,333}$$

For the calculation of storage costs per unit per year, the basic materials are:

$$H = \frac{\text{Total holding cost}}{\text{Total demand basic material}}$$

$$H = \frac{\text{IDR. 1.900.000}}{1.068}$$

$$H = \text{IDR. 1.779,026/set}$$

Sentral Sport Store also used the main raw material made of wood and carbon. The lumber was obtained from a regular distributor located in Cirebon. Sentral Sport Store orders these basic materials twelve times in one year. And every purchase of these materials is calculated for the purchase of basic materials once a month.

For the calculation of each purchase of wood base materials is

$$Q = \frac{\text{Total demand basic material}}{\text{Ordering frequency}}$$

$$Q = \frac{1.068}{12}$$

$$Q = 89 \text{ sets}$$

From the results of the calculations by Sentral Sport Store, each purchase of the basic material of a piece of wood which is made once every 1 month is 89 pieces of wood.

The next stage, Sentral Sport Store can calculate the amount of inventory costs. It can be seen that the number of basic materials needed (D) is 1,068 sets, the purchase of basic wood materials (Q) is 89 sets, the cost of ordering each order (S) is IDR.95,833.333, and the cost of storing/assembling (H) is IDR. 1,779,026 / unit/ year. So, with the data that is already known, Sentral Sport Store can calculate the total cost of supplying these basic materials.

For the calculation of the total cost of inventory is

$$\text{Total inventory cost} = \left(\frac{D}{Q}S\right) + \left(\frac{Q}{2}H\right)$$

$$\text{Total inventory cost} = \left(\frac{1.068}{89} \text{IDR. 95.833,333}\right) + \left(\frac{89}{2} \text{IDR. 1.779,026}\right)$$

$$\text{Total inventory cost} = \text{IDR. 1.149.999,996} + \text{IDR. 79.166,657}$$

$$\text{Total inventory cost} = \text{IDR. 1.229.166,653}$$

It can be concluded that the total cost of inventory spent by the Sentral Sport Store is IDR 1,229,166.653.

After some data is obtained, the Economic Order Quantity calculation process can be carried out with known data, namely the number of basic material requirements (D) is 1,068 sets, the cost of ordering each order (S) is IDR.95,833.333, and the cost of storage/assembly (H) is

IDR 1,779,026/set. So, with the known data, Sentral Sport Store can make purchase calculations that are relatively more affordable by calculating the Economic Order Quantity. For the calculation of purchases that are relatively more affordable or the Economic Order Quantity is:

$$EOQ = \frac{\sqrt{2SD}}{H}$$

$$EOQ = \frac{\sqrt{2 * IDR. 95.833,333 * 1.068}}{IDR. 1.779,026}$$

$$EOQ = 339,209 \text{ Sets}$$

It can be concluded that the purchase calculation results are relatively more affordable by calculating the Economic Order Quantity, which is 339,209 units.

With the calculation of the Economic Order Quantity, it can be continued with the calculation of the frequency of purchasing basic materials within 1 year. The calculation used is

$$Frequency (F) = \frac{D}{Economic Order Quantity}$$

$$Frequency (F) = \frac{1.068}{339,209}$$

$$Frequency (F) = 3,14 \text{ or } 3 \text{ times}$$

It can be concluded from the results of the calculation of the frequency of purchases of basic materials as many as 3 purchases within 1 year.

To calculate the total cost of inventory using the Economic Order Quantity basis, data can be seen such as the number of basic material requirements (D) is 1,068 sets, purchases that are relatively more affordable (Q) are 339,209 sets, the cost of ordering each order (S) is IDR.95,833.333, and the cost of storage/assembly (H) is IDR.1,779.026/assembly. The calculation used is:

$$Total \text{ cost Inventory } EOQ = \left(\frac{D}{Q}S\right) + \left(\frac{Q}{2}H\right)$$

$$Total \text{ cost Inventory } EOQ = \left(\frac{1.068}{339,209} IDR. 95.833,333\right) + \left(\frac{339,209}{2} IDR. 1.779,026\right)$$

$$Total \text{ cost Inventory } EOQ = IDR. 301.731,37989852 + IDR. 301.730,815217$$

$$Total \text{ cost Inventory } EOQ = IDR. 603.462,19511552$$

The calculation result of the supply of basic materials on the basis of the Economic Order Quantity at the Central Sport Store is IDR 603,462.19511552.

To calculate safety stock which is useful for knowing production activities, but it must be preceded by calculating the standard deviation. In the calculation process, relevant statistical data is needed to find the average comparison of basic ingredients. The following is the standard deviation calculation data:

Table 5. Standard Deviation Calculation

No	Month (n)	Total basic material (x)	Average (\bar{x})	($x - \bar{x}$)	($x - \bar{x}$) ²
1	January	53	89	-36	1.296
2	February	57	89	-32	1.024
3	March	67	89	-22	484
4	April	68	89	-21	441
5	May	106	89	17	289
6	June	132	89	43	1.849

7	July	150	89	61	3.721
8	August	124	89	35	1.225
9	September	97	89	8	64
10	October	42	89	-47	2.209
11	November	93	89	4	16
12	December	79	89	-10	100
TOTAL					12.718

Source : Data compiled

With the calculation of the standard deviation, it can be entered into the related formula:

$$\text{Standar deviation (Sd)} = \frac{\sqrt{\sum(x - \bar{x})^2}}{n - 1}$$

$$\text{Standar deviation (Sd)} = \frac{\sqrt{12.718}}{11}$$

$$\text{Standar deviation (Sd)} = 34,003$$

Toko Sentral Sport provides a possibility if the store experiences a 5% shortage of material (α), then if the store can fulfill 95% of the material supply. It can be seen that meeting the inventory of 95%, the Z value is 1.64. Obtained from the normal distribution table, look for the closest value and have the smallest difference with the value $\alpha = 0.05$. So that the closest value can be found, namely 0.051025, which is in a vertical position in row 1.6 and horizontally in row 0.035. So, the value of 1.64 is the result of a calculation of $1.6 + 0.035 = 1.635$ or 1.64. When the Z value is known, the safety stock calculation can be carried out using the formula obtained :

$$\text{Safety stock} = Sd \times Z$$

$$\text{Safety stock} = 34,003 \times 1,64$$

$$\text{Safety stock} = 55,765 \text{ or } 56 \text{ sets}$$

The results of the safety stock calculation prepared by the sentral Sport Store are 56 sets. In the process of calculating the Reorder Point at the Sentral Sport Store every time order the basic wood material, the waiting time for the order until the basic material arrives (L) is 10 days. Working time in 1 year is about 300 days. So it can be calculated $d = \left(\frac{D}{t}\right) = \frac{1.068}{300} = 3,58$ and calculation of $ROP = d \times L = 3,58 \times 10 = 35,8$ or 36 sets. $ROP = 56 + 36 = 92$ sets

It can be concluded that orders can be made again if the inventory level reaches 92 sets. From the calculation results which are relatively more affordable using the Economic Order Quantity basis, the following table can be presented;

Table 6. Comparison of Provision Store Results with Economic Order Quantity Basis

Subject	Store provision	Economic Order Quantity
Average purchase of basic materials	89 sets	339,209 sets
Total inventory cost	IDR.1.229.166,653	IDR. 603.462,19511552
Purchase Frequency	12 times	3 times
Safety stock	-	56 sets
Reorder point	-	92 sets

It can be concluded that the Q determined by the shop is a number of 89 sets and the Q resulting from the calculation of the Economic Order Quantity is a number of 339 sets, so that it can be said that using this calculation method can change the amount of purchase of basic materials with an increase of approximately 4 times more. It can also be seen that the total cost of inventory issued by the store is IDR. 1,229,166.653, and the total cost of inventory on the basis of EOQ is IDR. 603,462.19511552.

So that the cost that is saved and can be used as an advantage by the store every time you place an order for basic material is $\text{IDR. } 1,229,166.653 - \text{IDR. } 603,462.19511552 = \text{IDR. } 625,704.458, -$. With the calculation of the Economic Order Quantity, the cost of inventory is lower than the cost of the provisions of the store, so that the Economic Order Quantity method can be applied to this Sentral Sport Store. And, with the results of this research, Sentral Sport Store when purchasing basic materials using the Economic Order Quantity method looks more affordable so that it can save on inventory costs incurred and make the store get relatively more adequate profits.

6 CONCLUSION

Based on the results obtained from the analysis and discussion, it can be concluded that using the Economic Order Quantity basis can help the Sentral Sport Store in managing all of its store's inventory activities. And Sentral Sport Store can generate more adequate profits again. By using the basic calculation of the Economic Order Quantity used at the Sentral Sport Store, the store can advance quickly and precisely, which saves IDR. 625,704.458 per year..

SUGGESTION

Suggestion can be given to the Sentral Sport Store, that in buying supplies of basic materials, both the main basic materials and complementary materials. It is better to be able to carry out an analysis process for these purchases, in order to find out the optimal amount of basic material inventory. So that these supplies are not piled up in warehouses excessively and certainly so that the Sentral Sport Store can manage the production of these goods properly to get a amount of more adequate profits. And it is recommended to carry out the next analysis, Sentral Sport Store can carry out an analysis on the basis of calculating the Economic Order Quantity which can provide support in the production process.

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